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(54) Ink jet printer having a print head for applying a protective overcoat

(57) The subject of the invention relates to an ink jet printer, comprising: a) an ink jet printhead (13) for forming an image on a receiver media (12); and b) an overcoating head (11) for applying an overcoat layer over the image on the receiver media (12).

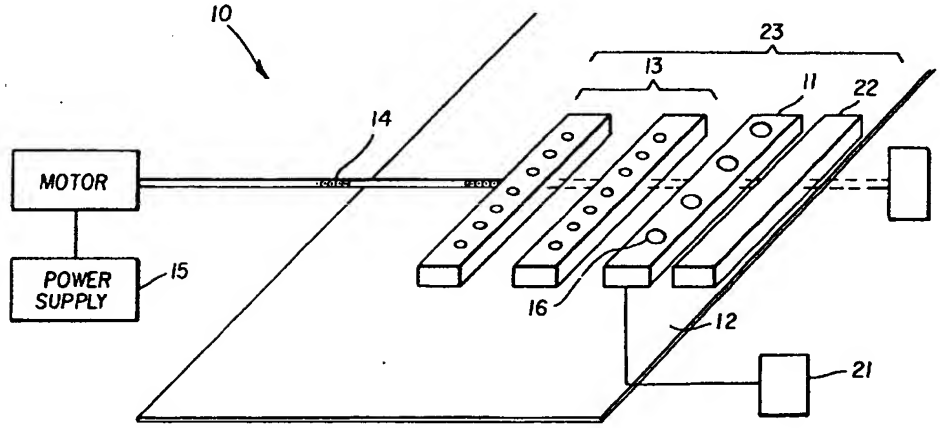

FIG. 1

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Description

FIELD OF THE INVENTION

[0001] The invention relates to ink jet printing and in particular to a method and apparatus for applying a protective overcoat to an ink jet print.

BACKGROUND OF THE INVENTION

[0002] Ink jet printing is one of the most popular methods in general use today in converting digital images into hard copy prints. Ink jet printers employ one, or a plurality of ink jet heads to place a stream of ink dots on a recording medium. Inks used in this process are well known in the art and they generally contain water, organic solvents and dyes. In general there are two types of ink used in the printing of ink jet images: those that employ high organic solvent based inks, and those that are aqueous. The images printed by either of these two types of inks may have poor water resistance, and low scratch, abrasion, smudge, and ultraviolet light resistance. That is why it is advantageous to cover ink jet prints used in public and outdoor displays with a protective overcoat commonly referred to as a laminate. The protective layer is positioned on top of the printed ink jet receiving media to protect it against water, moisture, and ultra violet damage. This process is done today printing the ink jet print first and then sending the print and laminate sheet(s) through a separate machine for heat and pressure treating of the laminate sheet to the print. The machines use an array of heating elements and pressure rollers to fix the laminate to the surface of prints.

[0003] The process as stated above is time consuming and expensive. The users need to own two pieces of equipment to print and laminate their images. The process is mostly done by hand, and a percentage of prints have to be discarded due to problems in the laminating process.

[0004] U. S. Patent No. 4,426,431, issued January 17, 1984 to Harasta et al., entitled "Radiation-Curable Compositions for Restorative and/or Protective Treatment of Photographic Elements" discloses a series of radiation curable compositions useful for forming protective coating on photographs.

[0005] U. S. Patent No. 4,595,931, issued June 17, 1986 to Toganoh et al., entitled "Recording Method" discloses an ink jet printing system which automatically laminates a sheet of transfer material to the print surface. After pressure contacting the laminate to the print surface, the carrier sheet is removed. The transfer material remains on the surface of the print.

[0006] U. S. Patent No. 5,162,179, issued November 10, 1992 to Lewicki, Jr., et al., entitled "Electrographic Structure and Process" discloses an electrophotographic printing system which uses a laminate to protect the printed image on the medium. The laminating is performed as the last step before the image is removed from the printer.

[0007] U. S. Patent No. 5,601,685, issued February 11, 1997 to Morse et al. entitled "Laminator and Loading System Therefor" discloses a laminating apparatus with a loading slot to facilitate the loading of a web through a nip located between a supply and take up spindle.

[0008] U. S. Patent No. 5,300,182, issued April 5, 1994 to DeCook et al. entitled "Laminator Apparatus for Making Image Proofs" discloses a laminator apparatus for making image proofs.

SUMMARY OF THE INVENTION

[0009] The problems noted above are solved according to the present invention by providing an ink jet printing system having an ink jet printhead for forming an image on a receiver media and an overcoating head for applying an overcoat layer over the image on the receiver media.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

Fig. 1 is a schematic diagram illustrating an ink jet printer having a protective overcoating head according to the present invention;

Fig. 2 is a schematic diagram illustrating the operation of the protective overcoating head shown in Fig. 1;

Fig. 3 is schematic diagram illustrating one configuration of the orifices in the overcoating head shown in Fig. 2;

Fig. 4 is schematic diagram illustrating another configuration of the orifices in the overcoating head shown in Fig. 2; and

Fig. 5 is schematic diagram illustrating a still further configuration of the orifices in the overcoating head shown in Fig. 2.

DETAILED DESCRIPTION OF THE INVENTION

[0011] Referring to Fig. 1, an ink jet printing system 10 according to the present invention is shown. It will be understood that the configuration is shown in conventional form. According to the invention, the ink jet printing system 10 employs an extra print head to apply an overcoat material to the receiving media 12. This extra print head is herein referred to as the overcoating head 11 which is positioned in line after the printhead 13 (in case of black and white printing) or printheads (in case of color printing). This configuration is shown in Fig. 1. The printhead 13 and overcoating head 11 are moved back and forth across the receiver media 12 by a lead screw 14 and is motor powered by a power source 15 in the printer. Adjacent to the overcoating head 11 is arranged a radiation source 22. The printhead 13, the

overcoating head 11 and the radiation source 22 form a unit 23 which is moved back and forth over the receiver media 12.

[0012] It is desirable that the addition of this overcoating head 11 should not slow down the printing process. In ink jet printing, the throughput, maximum rate of covering area A is given by:

$$\frac{dA}{dt} = \frac{N*f}{R^2},$$

wherein

A = area
N = number of nozzles
f = firing rate
R = resolution (1/size of the printed area per drop)

[0013] In printing a color image, the image quality is improved by increasing the resolution R. In order to keep throughput constant, the parameters N and/or f have to be increased in proportion to the increase in the square of R. This translates into higher costs since more complex print heads with a larger number of nozzles and higher firing rates are needed. But in the process of applying a clear overcoat to the image, the image quality is not a concern. Therefore it is advantageous to increase the size of the nozzles 16 in the overcoating head 11 and hence the size of the overcoat fluid spots 17 on the receiver media 12. By increasing the size of the nozzles 16 in the overcoating head 11, the size of N and f will remain constant or even decrease, without decreasing the printing speed of the system.

[0014] The overcoat material which is applied to the receiver media 12 has to confer the desired physical properties of toughness, scratch and abrasion resistance and weather fastness. On the one hand the overcoat material has to remain liquid in the overcoating head 11 and on the other hand it should dry quickly once applied to the receiver media 12. Various classes for overcoating material are known in the art. All of these materials contain a binder component, which gives cohesion and adhesion to the coated receiver media. A solvent may be present in the overcoating material, to dissolve those binders which may be solid or gel-forming at room temperature. A pigment component may or may not be present, although its presence might be used to modify optical properties of the overcoat layer if desired.

[0015] Possible binder materials include those which form a film as a result of the evaporation of solvents including cellulose, vinyl resins such as PVC or PVA, and natural resins. Other possible binders are:

- those that dry by oxidation processes such as varnishes and alkyd resins;
- those that may be set thermally such as water soluble alkyd, alkyd resins, acrylic resins and epode resins;
- those that are cured by application of radiation, including Ultraviolet, X-ray or electrons.

[0016] A preferred system using these materials is described in U. S. Patent No. 4,426,431 to Harasta et al. The system has the advantage of providing an overcoat with excellent physical properties, and further no removal of solvent is necessary. The curing step can be carried out by passing the print with film to be cured under a single Hg 118 UV lamp at a distance of 6.5 cm, and at a speed of up to 50 cm/second.

[0017] The overcoating head 11 of the present invention provides a contiguous overcoat film layer, substantially transparent, and with the thickness in a useable range of from 1 to 1000 micro-meters.

[0018] In order to provide a contiguous film, it is advantageous for the drops of overcoat material to be deposited to overlap with the previously deposited drops of overcoat material before the previously deposited drops have dried. This requirement is opposite to the requirement from the ink depositing head which forms the image, and results in the need for larger ratio of nozzle diameter and/or spot size(s) on the receiver media 12 to raster pitch P in the overcoating head 11.

[0019] An example of such a overcoating head 11 is shown in Fig. 2. This embodiment of the present invention is described using a piezoelectric type ink jet overcoating head 11.

[0020] The overcoating head 11 comprises channels 19 for the throughflow of an overcoat liquid. These channels 19 are connected to a reservoir 21 for the overcoat liquid and are separated by piezo walls 20. This part of the overcoating head 11 facing the receiver media 12 is covered by an orifice plate 18, which is provided with nozzles 16, one for each channel 19.

[0021] In Fig. 2, P is the pitch or spacing between the nozzles, and d_{noz} is the diameter of the nozzles 16 in the orifice plate 18. These may be adjusted by design of the orifice plate 18 which are made by a number of different ways and are all well known in the art. These methods are electro-plating. laser ablation, metal stamping or a host of other means. Also in Fig. 2, s is the size (diameter) of the deposited overcoat fluid spots 17 on the receiver media 12. Size s depends on the fluid and receiver media properties, and the size of the nozzle diameter (d_{noz}). V is the vertical spacing between lines of spots deposited on the receiver media 12. This depends on the (ΔT_{head}), the firing cycle time of the overcoating head and on v_{rec}, the linear velocity of the receiver media 12 with respect to the overcoating head 11.

$$V = v_{rec} * \Delta T_{head}$$

wherein

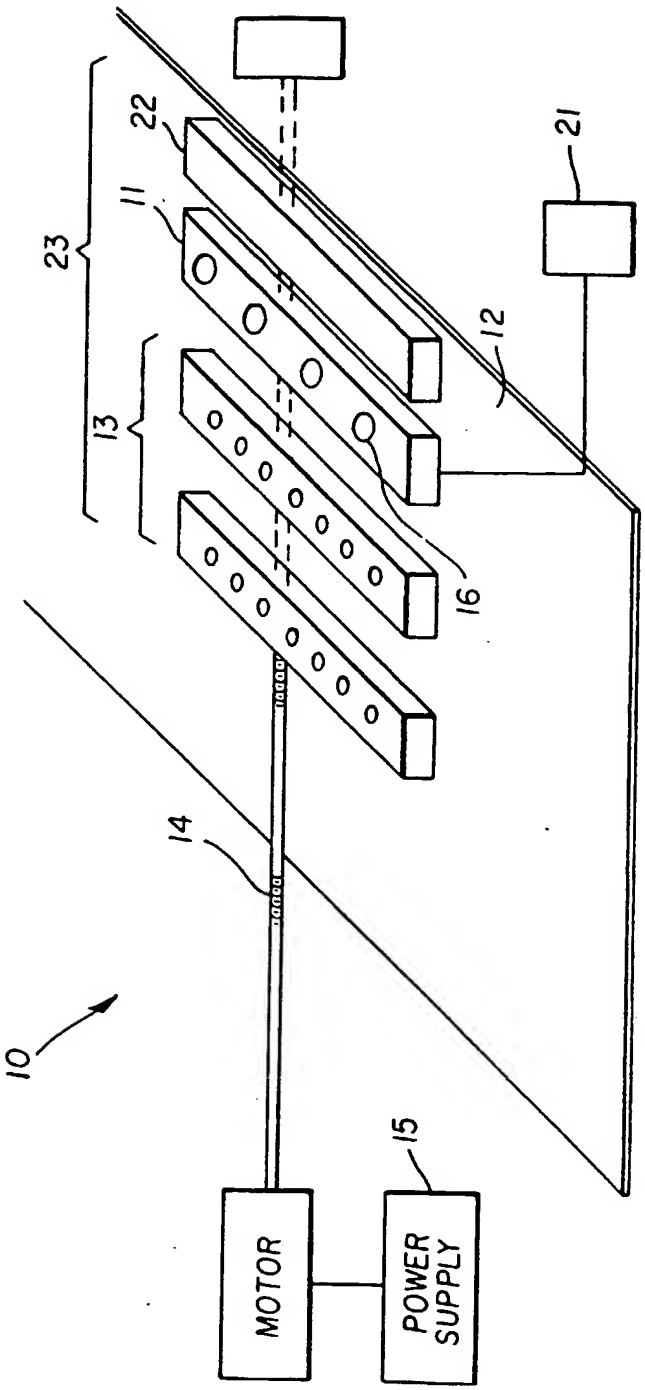

FIG. 1

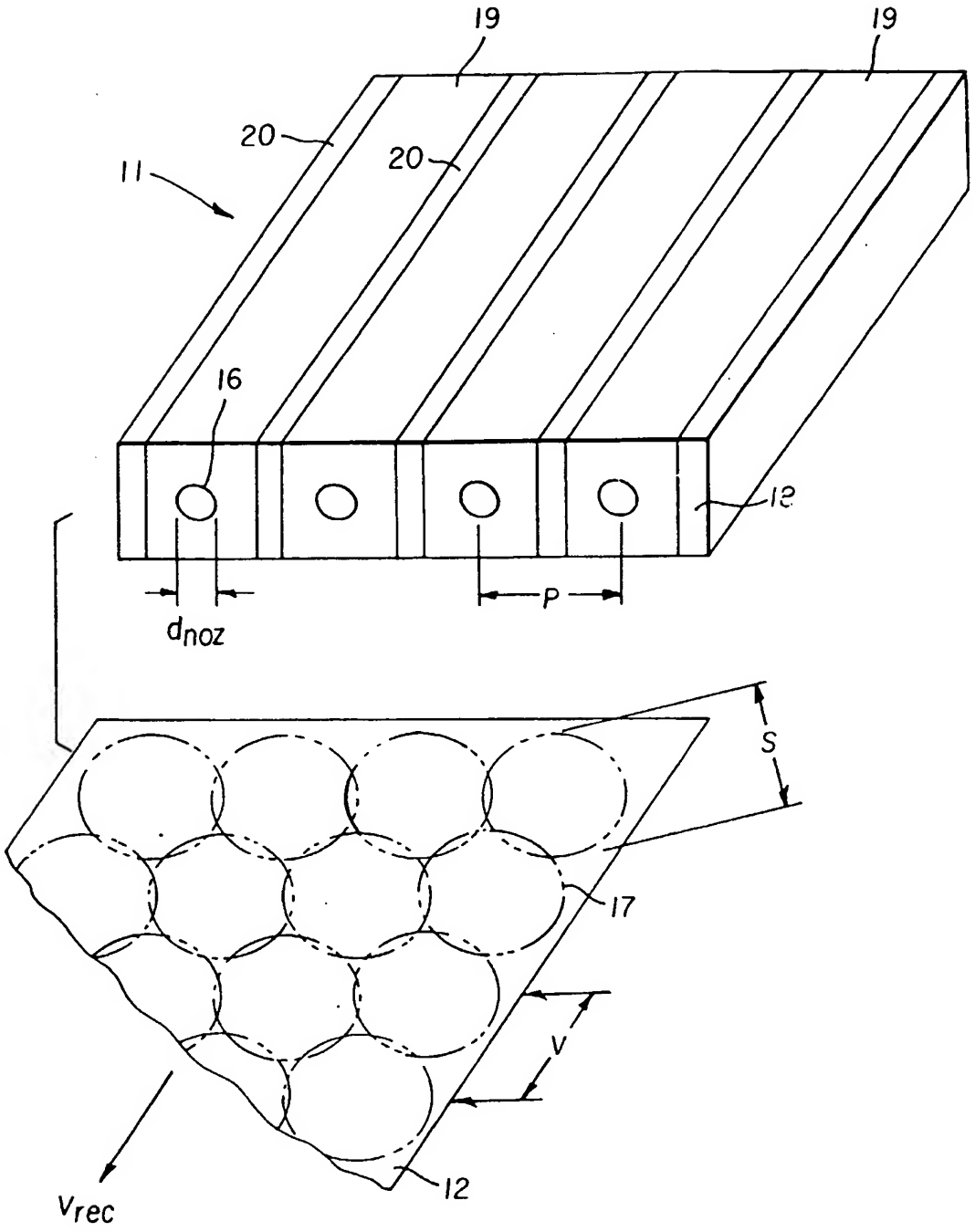

FIG. 2

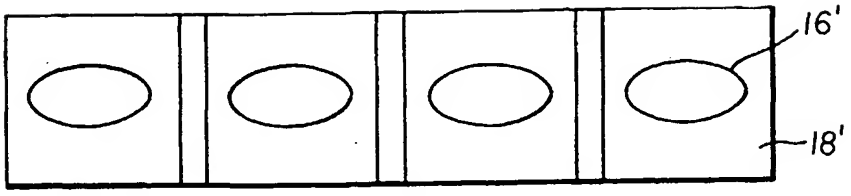

FIG. 3

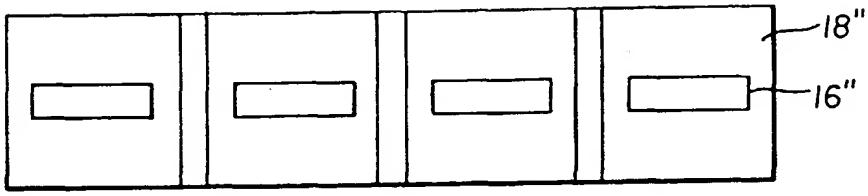

FIG. 4

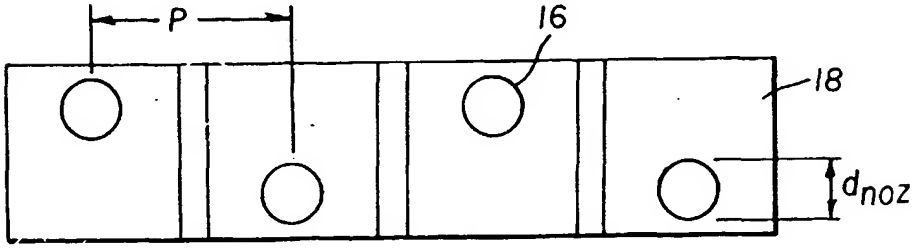

FIG. 5